| | Type | L # | Hits | Search Text | DBs | Time Stamp |
|---|---|---|---|---|---|---|
| 1 | BRS | L1 | 85551 | malfunction or (hardware adj failure) | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:21 |
| 2 | BRS | L2 | 171451 | aircraft or aerospace | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:21 |
| 3 | BRS | L3 | 27246 | display near ( color or colour) | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:22 |

09/990,051

| | Type | L # | Hits | Search Text | DBs | Time Stamp |
|---|---|---|---|---|---|---|
| 4 | BRS | L4 | 438 | identical adj (processors or controllers or CPUs) | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:23 |
| 5 | BRS | L5 | 123 | redundancy adj management | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:23 |
| 6 | BRS | L6 | 0 | 1 and 2 and 4 and 5 | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:24 |

| | Type | L # | Hits | Search Text | DBs | Time Stamp |
|---|---|---|---|---|---|---|
| 7 | BRS | L7 | 2 | 1 and 4 and 5 | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:26 |
| 8 | BRS | L9 | 0 | 1 and 4 and 8 | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:26 |
| 9 | BRS | L10 | 0 | 1 and 3 and 8 | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:26 |

| | Type | L # | Hits | Search Text | DBs | Time Stamp |
|---|---|---|---|---|---|---|
| 10 | BRS | L11 | 0 | 5 and 8 | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:26 |
| 11 | BRS | L8 | 108 | 345/618.ccls. | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:31 |
| 12 | BRS | L12 | 32151 | color near (change or vary) | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:32 |

| | Type | L # | Hits | Search Text | DBs | Time Stamp |
|---|---|---|---|---|---|---|
| 13 | BRS | L13 | 0 | 1 and 12 and 8 | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:32 |
| 14 | BRS | L14 | 4 | "fault-tolerant" and 12 | USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB | 2002/01/15 12:38 |

US005812102A

# United States Patent [19]

Sprole, Jr. et al.

[11] Patent Number: 5,812,102

[45] Date of Patent: Sep. 22, 1998

[54] VITAL MONITORING SYSTEM FOR SEVEN-SEGMENT DISPLAY USED IN RAILROAD APPLICATIONS

[75] Inventors: Bernard J. Sprole, Jr., Cranberry Township, Butler County; David E. Cichowski, Lower Burrell, both of Pa.

[73] Assignee: Union Switch & Signal Inc., Pittsburgh, Pa.

[21] Appl. No.: 815,249

[22] Filed: Mar. 12, 1997

[51] Int. Cl.[6] ..... G06F 3/14

[52] U.S. Cl. ..... 345/34; 345/46; 345/117

[58] Field of Search ..... 345/32–54, 117, 345/207; 340/815.44

[56] References Cited

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 3,573,814 | 4/1971 | Lang | 340/381 |
| 3,790,946 | 2/1974 | Hendricks | 340/336 |
| 4,095,217 | 6/1978 | Tani et al. | 340/324 |
| 4,242,677 | 12/1980 | Jonath | 340/715 |
| 4,247,852 | 1/1981 | Utzinger | 340/715 |
| 4,297,692 | 10/1981 | Maier | 340/715 |
| 4,311,993 | 1/1982 | Strobel | 340/641 |
| 4,408,869 | 10/1983 | Tomosada et al. | 355/14 |
| 4,420,748 | 12/1983 | Jurgen | 340/715 |
| 4,541,066 | 9/1985 | Lewandowski | 364/580 |
| 4,592,003 | 5/1986 | Kobayashi et al. | 364/579 |
| 4,644,341 | 2/1987 | Warner | 340/753 |
| 4,734,688 | 3/1988 | Adams | 340/715 |
| 4,847,606 | 7/1989 | Beiswenger | 340/712 |
| 4,951,037 | 8/1990 | Goossen | 340/715 |
| 5,160,920 | 11/1992 | Harris | 340/765 |
| 5,406,301 | 4/1995 | Ravid | 345/34 |
| 5,446,564 | 8/1995 | Mawatari et al. | 359/72 |
| 5,515,390 | 5/1996 | Benton | 371/57.1 |

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[57] ABSTRACT

A system and method of monitoring light emitted from a light emitting diode (LED) display device, which typically has a plurality of selectively energizable display segments which are grouped to form desired shapes and/or alphanumeric characters, is provided, particularly for use in an Aspect Display Unit (ADU) that requires vitality when utilized in the railroad industry as a component of an Automatic Train Protection system utilized in the railroad industry. In a preferred embodiment, each particular segment of the LED display device is independently monitored by an accompanying independent dual photo-transistor circuit when a non-vital output periodically drives each segment to a known electrical state and then back to the original state. A first and a second photo-transistor is used for each segment of the LED display. Each segment and the accompanying first and second phototransistor is surrounded by a shield which prevents light from other segments from being detected by the particular first and second photo-transistor. The first photo-transistor is directed toward the particular segment to sense light emitted therefrom and ambient light thereabout, while the second photo-transistor is directed away from the particular segment sense only ambient light thereabout that segment. The first and second photo-transistors generate electrical signals which are representative of the light detected by each of the first and second photo-transistors. The generated electrical signals drive a monitoring circuit which generates error signals representative of malfunctioning LED display segments, based on a comparison to a fixed voltage of a difference in voltages provided from the first and second photo-transistors.

**20 Claims, 5 Drawing Sheets**